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The Effect of Business Mathematics Instruction on Student Performance in Learning to Operate Office Calculating Machines.

Oluremi Raphael Aina
Northern Michigan University

THE EFFECT OF BUSINESS MATHEMATICS INSTRUCTION ON STUDENT PERFORMANCE IN LEARNING TO OPERATE OFFICE CALCULATING MACHINES

by

Oluremi Raphael Aina

Bachelor of Science, 1973
Western Michigan University

An Independent Study

Submitted to

Dr. Robert N. Hanson, Professor

Office Administration and Business Education Department

of

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This independent study submitted by Oluremi Raphael Aina in partial fulfillment of the requirements for the degree of Master of Science at Northern Michigan University, Marquette, Michigan, is hereby approved by the Advisor under whom the work has been done.

Robert N. Hanson
Advisor

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The writer also expresses appreciation to Mr. Jack Eldridge and Miss Lynda Gunderman who read the original manuscript.

DEDICATION

To Ebun and Kola, and to the memory of my brother, Taiye, for the value he placed on education.

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ABSTRACT

THE EFFECT OF BUSINESS MATHEMATICS INSTRUCTION ON STUDENT PERFORMANCE IN LEARNING TO OPERATE OFFICE CALCULATING MACHINES

Oluremi Raphael Aina, Master of Science

Northern Michigan University, 1974

Purpose

The purpose of this study was to compare the skill achievement of college Office Calculating Machines students who had remedial instruction in business mathematics prior to audio-visual tutorial instruction with the skill achievement of college students who did not receive remedial instruction in business mathematics prior to machine instruction.

Method and Sources

In the fall of 1973, 58 students enrolled in BE 234, Office Calculating Machines, at Northern Michigan University, Marquette; and in the spring of 1974, 44 students enrolled in the same course. These students were designated as subjects for the study. The two groups were administered a diagnostic test in business mathematics. The spring (experimental) group was then given three weeks of remedial instruction in business mathematics prior to individualized instruction on seven different office calculating machines.

The fall (control) group was not given remedial instruction in business mathematics and began their individualized study immediately.

Summary of Findings

In comparing the achievement of both groups, a t-test was used; and it was found that there was a significant difference in the mean performance test scores for the Olivetti Logos 250 Electronic Calculator at the .01 level of significance. A t-test was also used to determine that there were no significant differences in the mean performance test scores on the following machines: Underwood Olivetti Printing Calculator, NCR Full-Key Adding-Listing, NCR Ten-Key Adding-Listing, Friden Programmable Electronic Calculator, Burroughs Key-Driven Calculator, and Friden Rotary Calculator.

On the basis of the findings and conclusions of this study, the following recommendations are made:

1. Remedial instruction in business mathematics should precede instruction on the Olivetti Logos 250 Electronic Calculator.
2. Efforts should be made to select arithmetic principles and a textbook that parallel the topics being covered in Office Calculating Machines so that the knowledge gained in business mathematics can be applied on office calculating machines.
3. Office Calculating Machines at the college level should be restructured to include application problems in which there is an opportunity to apply the knowledge

of business mathematics to office calculating machines. Simulated business problems should be used.

4. Continued research should be conducted to examine achievement when combining calculating machines with other skill subjects such as accounting and office practice.
5. Research should be conducted at the secondary level to determine the effectiveness of integrating business mathematics with office calculating machines.
6. The validity and reliability of calculating machine performance tests should be established. Weaknesses with respect to these criteria may be contributing to the differences and/or similarity of student achievement on different machines.

CHAPTER I

INTRODUCTION

The increasing machines orientation by modern society is resulting in increased attention to business machines usage and instruction. Automation in the office has increased rapidly in the last few years; yet authorities point out that there is still an apparent need for business machines instruction as machines continue to be an important tool in the office.[1]

Since man changed from the barter system, he has needed business computations. In the early history of man, arithmetic was considered essential to business. In fact, the earliest arithmetic books principally contained business-type problems. Mathematics has been known to play a vital role in business transactions. This role has been simplified by the development of calculating machines.

Educators are in the forefront of how best to make calculators a useful tool for solving problems. Perhaps their biggest concern from time to time is how to teach more in less time.

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[1]E. Belford Carver, "An Experimental Study Integrating Business Mathematics and Business Machines at Southeastern Louisiana College," (doctoral dissertation, Arizona State University, 1970), p. 1.

One approach to the teaching of office calculating machines is to broaden the students' understanding of the basic principles of arithmetic by integrating business mathematics and office calculating machines.

Statement of the Problem

The objective of the study was to determine whether or not there were differences in achievement between college students who were given remedial instruction in business mathematics prior to an individualized audio-visual tutorial course in office calculating machines and college students who had the same individualized audio-visual tutorial instruction in office calculating machines but did not receive remedial instruction in business mathematics.

The null hypotheses upon which the study was based were:

1. Students who are given remedial instruction in business mathematics prior to individualized audio-visual tutorial laboratory instruction will learn to operate various office calculating machines with the same level of proficiency as students who do not receive remedial instruction in business mathematics prior to the individualized audio-visual tutorial laboratory instruction on office calculating machines.
2. Students who are given remedial instruction in business mathematics prior to individualized audio-visual tutorial laboratory instruction will spend the same amount of time learning to operate various office calculating machines

as students who do not receive remedial instruction in business mathematics prior to the individualized audio-visual tutorial laboratory instruction on office calculating machines.

Purpose of the Study

The main purpose of the study was to compare the skill achievement of college office calculating machines students who used only the individualized audio-visual tutorial laboratory approach with the skill achievement of college office calculating machines students who received remedial instruction in business mathematics prior to receiving the same individualized instruction.

A second purpose of the study was to identify, by the use of a diagnostic test, the students needing remedial instruction in business mathematics and then instructing them accordingly.

Need for the Study

A number of writers in the field have advocated the need for more arithmetic ability in the classroom as well as on the job. Businessmen especially have been very critical of the arithmetic ability of their young employees. The critics emphasize the importance of business arithmetic skill development and attempt to establish the premise that

business arithmetic should be an integral part of training for business.[1]

Some business educators have examined the achievement of their students in business arithmetic and found that students generally do not attain " . . . real proficiency in the subject."[2]

Some people claim that greater thinking power and higher achievement can result from problem solving opportunities.[3]

From a review of the literature, however, there seems to be a limited amount of research evidence to support these claims. Therefore, the importance of this study is underscored by this lack of supporting evidence. This study will attempt to provide data to help fill some of these gaps.

Definitions of Terms in the Study

Individualized instruction. This term refers to the course organization and the method of instruction used by the fall (control) and spring (experimental) groups. The method and course structure allowed students to learn at their individualized learning rates.

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[1]E. Belford Carver, "An Experimental Study Integrating Business Mathematics and Business Machines at Southeastern Louisiana College," (doctoral dissertation, Arizona State University, 1970), p. 1.

[2]William M. Polishook, "The Effectiveness of Teaching Business Arithmetic as a Separate Subject and as an Integral Part of Junior Business Training," (doctoral dissertation, New York University, 1945), p. 77.

[3]Wilbert E. Scheer, "Every Student Needs Mathematics," Business Education World, XLIV (January, 1964), 23.

Course. The term course refers to the subject Office Calculating Machines, BE 234, which was used for the study.

Audio-Visual Tutorial. This term is used to describe a method of learning in which primary instruction is presented on audio-visual media (cassette tapes and slides) to one student at a time in a carrel equipped with a tape player and a rotary slide projector.

Fall (Control) Group. This term is used to describe the subjects who did not receive remedial instruction in business mathematics. These students took the course (BE 234, Office Calculating Machines) in the fall semester of 1973.

Spring (Experimental) Group. This term is used to describe the subjects who received remedial instruction in business mathematics. The students took the course (BE 234, Office Calculating Machines) in the spring semester of 1974.

Business Mathematics. This term describes the application of arithmetic knowledge to solve business problems. It includes subject areas such as markup, discount, etc.

Limitations

Limitations of the study were:

1. The random selection of the population was not entirely within the control of the experimenter. Normally, students choose on their own to enroll in BE 234, Office Calculating Machines. Characteristically, however, the majority of them are college freshmen and sophomores.

2. Audio-visual equipment used for individualized instruction in the laboratory was at times inoperable, resulting in a loss of time for students.
3. Most of the subjects in the fall group were first-semester college freshmen who just left the high school only three months before. On the other hand, the spring subjects were mostly second-semester freshmen. This situation may present different motivational levels.
4. Some students in both groups might have failed to report properly the time spent on instruction in the lab.

Delimitations

The study was delimited to:

1. A diagnostic test in business mathematics comprised of problems in addition, subtraction, multiplication, and division, and application problems. (See Appendix A, page 34.) The diagnostic test was administered to all students in the two groups at the beginning of each semester--Fall, 1973, and Spring, 1974.
2. A three-week block of remedial instruction in business mathematics was devoted to the spring group. This treatment was designed to increase the students' competency in the fundamental processes of arithmetic and business mathematics.
3. The following areas were covered during the three-week block of remedial instruction in business mathematics: addition, subtraction, multiplication, division, business use of percentages, decimals, fractions, and financial charges.

4. The following office calculating machines were used for both groups:
   (a) Underwood Olivetti Printing Calculator
   (b) NCR Full-Key Adding-Listing
   (c) NCR Ten-Key Adding-Listing
   (d) Friden Programmable Electronic Calculator
   (e) Olivetti Logos 250 Electronic Calculator
   (f) Burroughs Key-Driven Calculator
   (g) Friden Rotary Calculator
5. Students were scheduled on a rotation basis from one calculator to another at the end of every two weeks on all machines except for the NCR Full-Key and NCR Ten-Key which were scheduled for one week each. (Copies of the rotation schedules are shown in Appendix B, page 39.)
6. Performance tests were administered to students at the end of each rotation period.
7. The study was delimited to only students who met the following requirements:
   (a) took the business mathematics diagnostic test
   (b) completed the individualized learning modules on each calculating machine
   (c) took all seven performance tests on the calculating machines
   (d) maintained a minimum of 90 percent attendance record during the three-week period of remedial instruction in business mathematics.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter refers to selected studies and literature that are relevant to the study. It is divided into two parts to reflect the various aspects of the study. The first part reviews selected studies that have recently been completed in the teaching of Office Calculating Machines. Areas covered include the rotation method, individualized instruction, and the use of calculators in a mathematics class. The second part deals with the integration of business arithmetic and calculating machines.

From the literature, it can be seen that instruction in business machines, in contrast to such subjects as shorthand and typewriting, has not been greatly researched. Commenting on the lack of research in the area of business machines and on why there was not much done in this area, Corgan said:

> Even in college, the business machine courses often have not received the attention they merited. Administrators assume that the students understand the business mathematics and that the machines can be learned adequately in a very short time. They are loathe to give academic credit to the course, fearing that it is only a skill course, and as such contains no intellectual or academic value.
>
> Unlike typewriting, which has attracted considerable research in methods and procedures, business machines has been the subject only of

> counting the number and types of machines taught in high school . . . however, there also has been a need for definite research in the area of teaching methods.[1]

It is noted, however, that the research that has been done provides good basic information for the business teacher. The inconclusiveness of the research not only justifies the concern of educators and businessmen concerning arithmetic skill and calculating machine operation but also points to the fact that the answer to efficient performance has not been found. Therefore, the search for methods that will improve efficiency of performance continues.

As is the case in most educational research, wide application of the findings of research that has been done in office calculating machines is needed because the true laboratory for educators is the classroom.

Studies in the Teaching of Office Calculating Machines

In a study comparing the rotation method and the similar-process methods of teaching calculating machines at the secondary school level, Corgan's investigations were inconclusive. She found, however, that a small advantage appeared to accrue to the students using the rotation method.[2]

Walters studied the effect of individualized taped instruction by college students. His was an experimental study comparing the achievement of two groups. The experimental

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[1]Virginia E. Corgan, "A Comparison of the Differences Between Similar-Processes Method and the Rotation Method of Teaching Business Machines" (unpublished doctoral dissertation, University of Nebraska, 1966), pp. 1-2.

[2]Ibid.

group used instructional tapes while the control group received instruction by the traditional method. He found no significant differences at the .05 level.[1]

Research has shown that students should be taught mastery of the machines rather than the development of high speed. Stutsman[2] and Chase[3] both report that instruction should lead the student to the acquaintancesship skill level rather than to high speed or to a high proficiency level.

In an experimental study comparing a business mathematics group using the pencil and paper method of computation with the group using calculators, Carver concluded:

> According to the results of this study, college business mathematics students who used calculators as a computational tool did not achieve significantly more on the business mathematics achievement test than those college students who did not use calculators in a business mathematics class.
>
> According to the results received on the calculator skill achievement test administered in this study, college students did not achieve significantly more in skill in the business machines course in which instruction was given on four types of calculators than in the business mathematics course in which instruction was given on one type of calculator.

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[1]George K. Walters, "The Effect of Taped Instruction on Achievement in College Office Machines" (doctoral thesis, University of Northern Colorado, 1968), p. 92.

[2]Galen Stutsman, "An Evaluation of the Operational Efficiency of Adding Machines and Calculating Machine Operations to Determine the Necessity for Formal Training" (doctoral thesis, Ohio State University, 1950), p. 117.

[3]Dayton K. Chase, "A Study to Identify the Basic Skills Needed with Adding and Calculating Machines for Office Positions with Implications for Improvement of Instruction in Office Machines" (doctoral thesis, University of North Dakota, 1965), p. 108.

> It is concluded that teaching students to use more than one type of calculator does not contribute to overall skill development.[1]

Integration of Business Arithmetic and Calculating Machines

Business educators are looking for better techniques and methods of instruction in order to teach more in less time with maximum efficiency. After considerable dissatisfaction with previous methods, Boise State College combined business arithmetic and calculating machines into one course with excellent results. Their original method included a course in business arithmetic covering remedial arithmetic, interest and discount, and office machines in which the student was expected to cover computation on two machines during one semester. The faculty observed that students rarely understood the procedures they used, and noted that there was little or no carry-over between office machines and business arithmetic.

A community survey was conducted to determine the extent to which machines were used and the types of calculations required of them. On the basis of the survey, the decision was made to integrate business arithmetic and calculating machines into a single course.

In a study conducted by Page, three groups of students each received different treatment:

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[1]E. Belford Carver, "An Experimental Study Integrating Business Mathematics and Business Machines" (doctoral dissertation, Southeastern Louisiana College, 1970), p. 90.

1. Instruction in business arithmetic
2. Instruction in calculating machines
3. Instruction in both calculating machines and business arithmetic.

The differences in the achievement scores in the three groups were not statistically significant at the .05 level of significance. A small advantage, however, appeared to accrue to the students in the integrated course that combined business arithmetic and calculating machines.[1]

Bryan recommended that office machines and mathematics be combined. He was convinced that this would contribute to better teaching procedures and that office machines instruction would become more meaningful to the school, the teacher, the student, the graduate, and the business which employs the graduate of this combination program.[2]

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[1]Charles W. Page, "Teaching Business Arithmetic and Calculating Machines as an Integrated Course" (doctoral thesis, University of Northern Colorado, 1970), p. 89.

[2]Ridgely D. Bryan, "Dual Purpose Plan of Teaching Office Machines," Business Education Forum, XIX (December, 1964), 14.

CHAPTER III

PROCEDURES

This chapter describes the design, procedures, and instrument used in the study.

Design of the Study

The design of the study can be classified as quasi-experimental. Campbell and Stanley refer to this type of research design as the "Nonequivalent Control Group Design."[1] Turney and Robb made the following comments concerning this design:

> This procedure makes use of a control group and an experimental group. Both groups are given a pretest and a posttest, but neither group is randomly selected from a larger population. Rather the groups constitute naturally assembled collectives such as classrooms, as similar as availability permits but yet not so similar that one can dispense with the pretest. Both are intact groups, thus indicating that no assumptions of equivalence can be made prior to the experiment.[2]

The authors described the condition being evaluated as "independent variable," (known conditions), and the criterion used to evaluate this condition is referred to as a "dependent variable."

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[1]D. T. Campbell and J. C. Stanley, "Experimental and Quasi-Experimental Designs for Research on Teaching," Handbook for Research on Teaching (Chicago: Rand McNally, 1963), p. 204.

[2]Billy L. Turney and George P. Robb, Research in Education: An Introduction (Hinsdale: Dryden Press, 1971), p. 68.

Selection of Groups

This section discusses the procedures for selecting the subjects and the control of the variables. The researcher is a Graduate Assistant with the responsibility for coordinating the Office Calculating Machines course at Northern Michigan University. He obtained the permission and cooperation of Dr. Robert N. Hanson, Head of the Department of Office Administration and Business Education, to use the students in BE 234, Office Calculating Machines, for this study.

The population consisted of students who enrolled in BE 234, Office Calculating Machines, in the fall of 1973 and in the spring of 1974. Students followed the usual college registration procedures and enrolled in the various sections of BE 234, Office Calculating Machines, without prior knowledge of the experiment. One hundred and twenty-six students originally enrolled in both semesters--73 students in the fall of 1973 and 53 students in the spring of 1974.

Because there are only twelve individualized learning carrels in the laboratory, the maximum student enrollment for each section was twelve; the classes were thus scheduled for seven sections, 58 students in the fall and 44 in the spring met the criteria for inclusion in the study. The 58 fall students were designated the control group and the 44 spring students constituted the experimental group. The two groups are simply referred to in this study as the spring (experimental) group and the fall (control) group.

In order to be included in the study, students had to meet the following criteria:

(a) Take the business mathematics diagnostic test

(b) Complete a course of remedial instruction in business mathematics (spring group)

(c) Take all seven performance tests on the calculating machines

(d) The spring (experimental) group students must have had a 90 percent minimum attendance record during the three week period of remedial instruction in businsss mathematics

(e) The spring (experimental) group students must have taken a progress test in business mathematics at the end of the three-week period of remedial instruction in business mathematics.

Teaching Media

The audio-visual media used for instructing students to operate the calculating machines was developed by the Department of Office Administration and Business Education at Northern Michigan University in the fall of 1970. The scripts for instructional procedure were tape recorded, and 35 mm colored slides were concurrently prepared to accompany the tapes. The instruction for each machine was broken down into modules. (Copies of modules for all seven machines are located in Appendix C, page 42.) This procedure enabled a student to go back to any segment as many times as he needed in order to understand it.

The calculating machines used for the study were:

1. Underwood Olivetti Printing Calculator
2. NCR Full-Key Adding-Listing
3. NCR Ten-Key Adding-Listing
4. Friden Programmable Electronic Calculator
5. Olivetti Logos 250 Electronic Calculator
6. Burroughs Key-Driven Calculator
7. Friden Rotary Calculator

A workbook entitled, A Drill Workbook for BE 234, Office Calculating Machines, prepared by the Department of Office Administration and Business Education at Northern Michigan University, was used by each student to practice the procedures learned on the tapes and slides. During the three-week block of remedial instruction in business mathematics for the spring group, a text entitled Business Mathematics for Colleges[1] was used.

Method of Instruction

Both the fall and spring groups were administered a diagnostic test in the basic concepts of business mathematics and arithmetic. (See Appendix A, page 34.) After the diagnostic test, the fall group was immediately given a general orientation to the calculating machines without a period of remedial instruction in business mathematics.

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[1]Louis A. Rice, F. Blair Mayne, and James E. Deitz, Business Mathematics for Colleges (Cincinnati: South-Western Publishing Co, 1973).

One-fifth of the course period or 12 class hours in business mathematics was devoted to remedial instruction in arithmetic for the spring group before machine instruction began. During the three-week period, the following topics were covered:

Part I. Fundamental Processes:

1. Addition
2. Subtraction
3. Multiplication
4. Division

Part II. Decimals and Fractions:

1. Decimals--Addition and Subtraction
2. Decimals--Multiplication and Division
3. Fractions--Addition and Subtraction
4. Fractions--Multiplication and Division

Part III. Percentages in Business:

1. Percentage Review
2. Cash and Trade Discount
3. Commission
4. Markups

Part IV. Financial Charges:

1. Simple Interest
2. Cash and Trade Discount
3. Discounting Commercial Paper
4. Charges for Credit

Part V. Progress Test.

The remaining part (4/5) of the spring semester was devoted to learning the operations of calculating machines.

Each student was required to learn the basic operations of a particular calculating machine by a prescribed date shown on the rotation schedule. (See Appendix B, page 39.) The instructions for the instructional program followed this pattern:

1. Check out the appropriate module from the lab assistant--slides and tapes.
2. Prepare the projector for projection by turning on the lamp. Start the cassette player.
3. View the slides and listen to the tape. Follow the instructions from both.
4. Do the problems on the appropriate pages of the drill workbook. Check your answers for accuracy. If you do not understand an operation, you may go back and view the slides and listen to the tapes again or ask your instructor for help.
5. Take the performance test when all the modules for a particular machine are completed.
6. Rotate to the next office calculating machine.

Collection of Data

The data used in this study were collected by four instruments: (1) Diagnostic test in business mathematics; (2) Performance test in business mathematics; (3) Performance tests on office calculating machines; and (4) Time cards.

Diagnostic Test.

A diagnostic test in arithmetic and business mathematics was developed by the researcher. The diagnostic test

consisted of 30 multiple-choice problems. (See Appendix A, page 34.) The time limit on the test was 40 minutes. The students in the spring semester who performed with 92 percent accuracy on the diagnostic test were to be exempted from the three-week period of remedial instruction in business mathematics; however, nobody scored high enough to be exempted.

Performance Test in Business Mathematics.

A performance test in business mathematics was adopted from the textbook for use at the end of the three-week period of remedial instruction in business mathematics. The test which consisted of 40 problems was divided into three sections: A, B, and C. (See Appendix D, page 50.) The sections followed a graduated order of difficulty. Section A contained short, easy problems; section B contained multiple-choice problems; and section C had application problems.

Performance Test in Office Calculating Machines.

The tests used for each machine at the end of the rotation period had been developed in 1970 by the Department of Office Administration and Business Education at Northern Michigan University. (See Appendix E, page 55.) Each test consisted of about 40 questions. A time limit of 40 minutes was set for each performance test. The students were required to turn in the machine paper tapes used on the tests. Performance scores were recorded on a progress chart opposite the students' names.

Time Cards.

Each student filled in a time card whenever he spent time learning the operations of a calculating machine, including the 40 minutes it took him to do the performance test. The time card contained the student's name, time in, time out, and the date. At the end of each week, a lab assistant calculated the total time in hours for each student and then recorded it on a time sheet. The total time spent in the lab during each rotation period was recorded with the student's score and posted on the bulletin board. (See Appendix F, page 70.)

CHAPTER IV

FINDINGS

In this chapter an analysis of the data collected for the study is presented. The chapter is divided into two parts. The first contains a discussion of the differences in the mean scores on the performance tests for both the fall (control) and spring (experimental) groups. The amount of time spent by both is analyzed in the second part.

Statistical Analysis of the Performance Tests

The skill of operation on all seven calculating machines for both the fall and spring groups was measured by a performance test administered individually at the end of each rotation period. The calculating machines used were: Friden Programmable, Olivetti Logos 250, NCR Ten-Key, NCR Full-Key, Olivetti Underwood, Friden Rotary, and Burroughs Key-Driven. The students were not permitted to use paper and pencil when computing the problems; all calculations had to be done using the calculating machines.

A t-test was used to test the null hypothesis that there was no significant difference in the mean performance test scores of the two groups. The raw scores on the performance tests for each student in both groups were used to compute the critical ratio in order to determine whether or

not the null hypothesis was to be rejected with respect to each calculating machine. (Raw scores for both groups are presented in Appendix G, page 72.)

In a comparison of the two groups based on the scores received on the performance test for the Olivetti Logos 250, Table 1 shows that there was a t ratio of 2.65. The null hypothesis for the Olivetti Logos 250 was rejected at the .01 level of significance. Indeed, there was a significant difference in scores obtained by the spring group which was given remedial instruction in business mathematics prior to instruction on the Olivetti Logos 250 Electronic Calculator.

TABLE I

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE OLIVETTI LOGOS 250

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	77.91	2.91	6.07	100	2.65	1.98	2.63
Spring	80.82		4.89				

Table 2, page 23, shows that for the NCR Full-Key there was a t value of 1.92 in a comparison of the two groups based on the scores received on the performance test. Therefore, the null hypothesis was retained. There was no significant difference in the scores obtained by the spring group which was given remedial instruction in business mathematics prior to instruction on the NCR Full-Key.

TABLE 2

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE NCR FULL-KEY

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	33.32	2.11	6.29	100	1.92	1.98	2.63
Spring	35.43		4.64				

In a comparison of the two groups based on the scores for the Friden Programmable, there was a t value of 0.93 indicating no significant difference in the mean scores of the two groups after the spring group was given remedial instruction in business mathematics prior to instruction on the Friden Programmable. Therefore, the null hypothesis was retained. See Table 3.

TABLE 3

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE FRIDEN PROGRAMMABLE

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	46.36	0.59	3.95	100	0.93	1.98	2.63
Spring	46.95		2.34				

Table 4 shows that for the Burroughs Key-Driven calculator, there was a t value of 0.99 when the two groups were compared based on the scores received on the performance test. The null hypothesis was retained. This shows that there was no significant difference in the mean scores of the two groups after the spring group was given remedial instruction in business mathematics prior to instruction on the Burroughs Key-Driven calculator.

TABLE 4

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE BURROUGHS KEY-DRIVEN

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	33.03	1.24	6.24	100	0.99	1.98	2.63
Spring	34.27		6.10				

Comparing the two groups based on the scores received on the performance test, Table 5, page 25, indicates that for the NCR Ten-Key Adding-Listing machine, there was a t value of 1.51. This shows no significant difference in the mean scores of the two groups after the spring group was given remedial instruction in business mathematics prior to instruction on the NCR Ten-Key Adding-Listing machine. The null hypothesis is retained.

TABLE 5

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE NCR TEN-KEY

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	35.24	1.34	4.93	100	1.51	1.98	2.63
Spring	36.58		3.87				

Table 6 shows that for the Olivetti Underwood calculator there was a t value of 0.54 when the two groups were compared. The null hypothesis was retained. This indicates that there was no significant difference in the mean scores of the two groups after the spring group was given remedial instruction in business mathematics prior to instruction on the Olivetti Underwood calculator.

TABLE 6

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE OLIVETTI UNDERWOOD

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	43.32	0.52	5.63	100	0.54	1.98	2.63
Spring	43.84		3.89				

In a comparison of the two groups based on the scores received on the performance tests on the Friden Rotary calculator, Table 7 shows that there was a t value of 1.33 indicating no significant difference in the mean scores of the two groups after the spring group was given remedial instruction in business mathematics prior to instruction on the Friden Rotary calculator. Therefore, the null hypothesis was retained.

TABLE 7

COMPARISON OF GROUPS ON THE BASIS OF SCORES RECEIVED ON THE FRIDEN ROTARY

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	29.27	1.36	4.97	100	1.33	1.98	2.63
Spring	30.63		5.12				

Statistical Analysis of the Time

Each student in both the spring and fall groups recorded on a time card the amount of instructional time spent on the media modules for all seven calculating machines. A minimum of four hours a week was estimated to be the time needed to complete each week's modules. At the end of each week, the total time spent working on a calculating machine was posted from the time cards to a master sheet. (The raw data for the amount of time spent by each student learning the basic operations of the calculators is reported in Appendix H, page 80.)

A t-test was used to test the null hypothesis that there was no significant difference in the amount of time students took to learn the basic operations of all seven calculating machines with or without prior remedial instruction in business mathematics.

The time it took each student to learn the basic operations of all seven machines was recorded in hours, and the total number of hours for each student was used for the analysis. Table 8 shows that a t value of 0.32 was obtained in a comparison of the groups based on the amount of time it took to learn the basic operations of all seven calculating machines. Since there was no significant difference, the null hypothesis was retained.

TABLE 8

COMPARISON OF GROUPS ON THE BASIS OF TIME SPENT ON THE CALCULATING MACHINES

Groups Compared	Mean Score	Mean Diff.	Std. Dev.	Degrees of Freedom	Critical Ratio (t)	Level of Significance 0.05	0.01
Fall	25.84	0.64	9.76	100	0.32	1.98	2.63
Spring	26.48		10.27				

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND OBSERVATIONS

Summary

This study was conducted to determine if there were significant differences in the skill achievement of college Office Calculating Machines students who had remedial instruction in business mathematics prior to learning how to operate calculating machines and those college students who did not receive remedial instruction in business mathematics prior to machine instruction.

The experiment took place during the fall semester of 1973 and the spring semester of 1974 at Northern Michigan University, Marquette. The sample consisted of 102 students. There were two groups in the study. Group I included 58 students enrolled in BE 234, Office Calculating Machines, in which students used a media instructional approach to learn the basic operations of seven calculating machines. Group II was composed of 44 students. This group was given three weeks of remedial instruction in business mathematics prior to using the media instructional approach to learn the basic operations of the same seven calculating machines. The groups were classes within the University and did not have

pre-experimental sampling equivalence. The two groups were simply referred to as fall (control) and spring (experimental) groups.

The specific null hypotheses for the study were:

1. Students who are given remedial instruction in business mathematics prior to individualized audio-visual tutorial laboratory instruction will learn to operate various office calculating machines with the same level of proficiency as students who do not receive remedial instruction in business mathematics prior to the individualized audio-visual tutorial laboratory instruction on office calculating machines.
2. Students who are given remedial instruction in business mathematics prior to individualized audio-visual tutorial laboratory instruction will spend the same amount of time learning to operate various office calculating machines as students who do not receive remedial instruction in business mathematics prior to the individualized audio-visual tutorial laboratory instruction on office calculating machines.

Data for this study were collected from two main sources: performance tests on the office calculating machines and time cards.

When a student completed the modules on each calculating machine, he took a performance test; and the raw

score was recorded. Also, the amount of time a student spent in learning the basic operations of a calculating machine was recorded on a time card.

It was found that there were no significant differences in the mean test scores of the students who had machine instruction with or without remedial instruction in business mathematics prior to learning the basic operations of the following office calculating machines: Underwood Olivetti Printing Calculator, NCR Full-Key Adding-Listing, NCR Ten-Key Adding-Listing, Friden Programmable Electronic Calculator, Burroughs Key-Driven Calculator, and Friden Rotary Calculator.

There was a significant difference at the .01 level for the mean scores of the two groups on the test to measure achievement on the Olivetti Logos 250 Electronic Calculator. The spring (experimental) group which received remedial instruction in business mathematics prior to machine instruction did display superior skill at the end of the instructional period.

It was found that there was not a significant difference between the two groups in the amount of time spent in learning the basic operations of all seven calculating machines.

Conclusions

Based on the findings of this study, it is concluded that remedial instruction in business mathematics prior to audio-visual laboratory instruction does not contribute to the learning of basic operations on the following office calculating machines: Underwood Olivetti Printing Calculator, NCR Full-Key Adding-Listing, NCR Ten-Key Adding-Listing, Friden Programmable Electronic Calculator, Burroughs Key-Driven Calculator, and Friden Rotary Calculator.

It is concluded, based on the findings of this study, that remedial instruction in business mathematics prior to audio-visual laboratory instruction does contribute to the learning of basic operations on the Olivetti Logos 250 Electronic Calculator.

Based on the findings of this study, it is also concluded that remedial instruction in business mathematics prior to audio-visual laboratory instruction does not affect the amount of time needed to learn the basic operations of all seven office calculating machines used in the study: Underwood Olivetti Printing Calculator, NCR Full-Key Adding-Listing, NCR Ten-Key Adding-Listing, Friden Programmable Electronic Calculator, Burroughs Key-Driven Calculator, Friden Rotary Calculator, and Olivetti Logos 250 Electronic Calculator.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are made:

1. Remedial instruction in business mathematics should precede instruction on the Olivetti Logos 250 Electronic Calculator.
2. Efforts should be made to select arithmetic principles and a textbook that parallel the topics being covered in Office Calculating Machines so that the knowledge gained in business mathematics can be applied on office calculating machines.
3. Office Calculating Machines at the college level should be restructured to include application problems in which there is an opportunity to apply the knowledge of business mathematics to office calculating machines. Simulated business problems should be used.
4. Continued research should be conducted to examine achievement when combining calculating machines with other skill subjects such as accounting and office practice.
5. Research should be conducted at the secondary level to determine the effectiveness of integrating business mathematics with office calculating machines.
6. The validity and reliability of calculating machine performance tests should be established. Weaknesses with respect to these criteria may be contributing to the differences and/or similarity of student achievement on different machines.

Observations

As a result of conducting this study, the researcher has become aware of certain implications which either directly or indirectly relate to office calculating machines and business mathematics. Although these remarks are not based on the data collected, they are presented to report some observations made during the study.

An analysis of student performance showed that the spring (experimental) students did better on the application problems, a particular feature of the performance test for the Olivetti Logos 250 Electronic Calculator. It may be that competency in business mathematics contributes more to machine performance on application problems than to simple computations.

Most of the students who had remedial instruction in business mathematics expressed favorable comments regarding the usefulness of the course. This was especially so with the use of the NCR Ten-Key and Full-Key machines. It is noted that these two machines were originally engineered for problems involving dollars and cents; the knowledge of arithmetic was important for solving non-monetary problems.

The methodology of audio-visual tutorial instruction for the teaching of office calculating machines enabled the students to go back to any steps they did not understand. This method earned favorable comments from the students. A wide application of this method of teaching will enable teachers to use more of their time in research needed to enhance the teaching profession.

APPENDIX A

DIAGNOSTIC TEST

BE-234 OFFICE CALCULATING MACHINES

DIAGNOSTIC TEST

Indicate the appropriate letter of the correct answer in the space provided.

1. The sum of 13 3/4 and 11 1/2 is

   (a) 24 1/2 (c) 25 1/4
   (b) 25 (d) 25 1/2 _____

2. Add 36 7/8, 42 1/2, 65 15/16, 127

   (a) 200 (c) 300
   (b) 270 (d) 272 5/16 _____

3. Add 5 hrs. 13 min., 3 hrs. 49 min., and 14 min.

   (a) 8 hrs. 16 min. (c) 9 hrs. 76 min.
   (b) 9 hrs. 16 min. (d) 8 hrs. 6 min. _____

4. Jane has two pieces of ribbon. One piece is 2 3/4 yards; the other 2 2/3 yards. To make the two pieces equal she must cut off from the longer piece

   (a) 9 inches (c) 6 inches
   (b) 8 inches (d) 3 inches _____

5. 1 1/4 subtracted from its reciprocal is

   (a) 1/5 (c) -4/5
   (b) -1/5 (d) 9/20 _____

6. Which of the following is the largest?

   (a) 2/3 - 1/8 (c) 4/5 - 1/8
   (b) 1/2 - 1/8 (d) 5/8 - 1/8 _____

7. Multiply 18 2/3 by 3 3/8

   (a) 60 (c) 68
   (b) 65 (d) 63 _____

8. The product of 8 ft. 7 in. multiplied by 8 is

(a) 69 ft. 6 in. (c) 68 2/3 ft.
(b) 68.8 ft. (d) 68 ft. 2 in. _____

9. 1/3 of 7 yards is

(a) 2 yards (c) 3 1/2 yards
(b) 4 yards (d) 7 ft. _____

10. Of the following, the one which is the equivalent of 2 1/5 is

(a) 1/5 of 2 (c) 2/5 of 1
(b) 2 and 1/5 of 1 (d) 2 and 1/5 of 2 _____

11. 7/8 divided by 2/7 is

(a) 1/4 (c) 9/15
(b) 3 1/6 (d) 4 1/16 _____

12. The value of 2 1/3 divided by 3/5 is

(a) 4 1/3 (c) 2 1/5
(b) 3 8/9 (d) 1 4/5 _____

13. If 4 1/2 is divided by 2 2/3, the quotient is

(a) 12 (c) 2 1/3
(b) 3 1/3 (d) 1 11/16 _____

14. Divide 7/8 by 7/8

(a) 1 (c) 7/8
(b) 0 (d) 49/64 _____

15. 1/2 divided by 1/4 equals

(a) 2 (c) 1/6
(b) 1/2 (d) 1/8 _____

16. What is the average of the following numbers? 798.54; 6.010; .783; 99.5; 86

(a) 196.296 (c) 196.516
(b) 196.496 (d) none of the preceding _____

17. A man earns $20.56 on Monday; $32.90 on Tuesday; $20.78 on Wednesday. He spends half of all that he earned during the three days. How much has he left?

(a) $29.19 (c) $34.27
(b) $31.23 (d) $37.12 _____

18. After an employer figures out an employee's weekly salary of $90.57, he deducts $3.05 for social security and $5.68 for pension. What is the amount of the check after these deductions?

(a) $81.84 (c) $81.93
(b) $81.92 (d) $81.99 _____

19. A school bought 172 sheets of composition board at $1.50 per C. The cost was

(a) $2.58 (c) $1.72
(b) $3.22 (d) $1.29 _____

20. 72 divided by .009 is

(a) .125 (c) 8,000
(b) 800 (d) 80 _____

21. What is the equivalent decimal of the fraction 7/8

(a) .785 (c) .575
(b) .675 (d) none of the preceding _____

22. A pair of equivalent value is

(a) 35%, 35.0 (c) 1 1/4%, .125
(b) 37.5%, 3 3/4 (d) 2 3/4%, .0275 _____

23. 37 1/2 written as a decimal is

(a) 37.5 (c) .00375
(b) 0.375 (d) .0375 _____

24. 5/17 expressed as a decimal is

(a) 1.27 (c) .29
(b) .34 (d) 3.40 _____

25. Successive discounts of 40% and 20% are equal to a single discount of

(a) 20% (c) 52%
(b) 30% (d) 60% _____

26. The price of an article has been reduced 25%. In order to restore the original price the new price must be increased by

(a) 20% (c) 33 1/3%
(b) 25% (d) 40% _____

27. John's father received a bonus of $450, which was 5% of his annual salary. His annual salary was

(a) $9,500 (c) $8,000
(b) $9,000 (d) $7,500 _____

28. 1/2% equals

(a) .002 (c) .005
(b) .020 (d) .050 _____

29. A bag contains 800 coins. Of these, 10 percent are dimes, 30 percent are nickles, and the rest are quarters. The amount of money in the bag is

(a) less than $150 (c) between $301 and $450
(b) between $150 and $300 (d) more than $450 _____

30. A typewriter was listed at $120.00 and was bought for $96.00. What was the rate of discount?

(a) 16 2/3% (c) 24%
(b) 20% (d) 25% _____

APPENDIX B

ROTATION SCHEDULES

BE 234 OFFICE CALCULATING MACHINES
ROTATION SCHEDULE

Fall 1973

	9/10-9/20	9/24-10/4	10/8-10/18	10/22-11/1	11/5-11/15	11/26-12/6
NCR Ten-Key*	1 2	3 4	5 6	7 8	9 10	11 12
NCR Full-Key*	2 1	4 3	6 5	8 7	10 9	12 11
Olivetti Logos 250	3 4	5 6	7 8	9 10	11 12	1 2
Friden Programmable	5 6	7 8	9 10	11 12	1 2	3 4
Friden Rotary	7 8	9 10	11 12	1 2	3 4	5 6
Burroughs Key-Driven	9 10	11 12	1 2	3 4	5 6	7 8
Olivetti Printing	11 12	1 2	3 4	5 6	7 8	9 10

*Only one week is spent on each of NCR Ten-Key and NCR Full-Key.

BE 234, OFFICE CALCULATING MACHINES
ROTATION SCHEDULE

Spring 1974

	1/15-2/14	2/18-2/28	3/4-3/14	3/18-3/28	4/2-4/11	4/15-4/25	4/29-5/9
NCR Ten-Key*	Business Mathematics	1 2	3 4	5 6	7 8	9 10	11 12
NCR Full-Key*		2 1	4 3	6 5	8 7	10 9	12 11
Olivetti Logos 250		3 4	5 6	7 8	9 10	11 12	1 2
Friden Programmable		5 6	7 8	9 10	11 12	1 2	3 4
Friden Rotary		7 8	9 10	11 12	1 2	3 4	5 6
Burroughs Key-Driven		9 10	11 12	1 2	3 4	5 6	7 8
Olivetti Printing		11 12	1 2	3 4	5 6	7 8	9 10

*Only one week is spent on each of NCR Ten-Key and NCR Full-Key.

APPENDIX C

CALCULATING MACHINE

LEARNING MODULES

BE 234, OFFICE CALCULATING MACHINES

OLIVETTI UNDERWOOD

Module		
1	Addition	_____
2	Subtraction	_____
3	Sub-Totals	_____
4	Repeat Lever/Addition	_____
5	Constant Addition	_____
6	Constant Subtraction	_____
7	Multiplication	_____
8	Multiplication of Decimals	_____
9	Multiplication, Constants	_____
10	Accumulation Multiplication	_____
11	Multiple Factor Multiplication	_____
12	Multiple Factor Decimals	_____
13	Division	_____
14	Division of Decimals	_____
	TEST SCORE	_____

BE 234, OFFICE CALCULATING MACHINES

NCR FULL-KEY ADDING-LISTING

Module		
1A	Addition	_____
1B	Addition with Credit Balance	_____
2	Subtraction with Credit Balance	_____
3A	Multiplication	_____
3B	Shortcut Multiplication	_____
4	Division with Reciprocals	_____
5	Discount, Net Amount/Rate of Discount	_____
	TEST SCORE	_____

BE 234, OFFICE CALCULATING MACHINES

OLIVETTI LOGOS 250

Module		
1A	Addition and Subtraction--Positive and Negative Totals	_____
1B	Addition and Subtraction with Decimals	_____
1C	Simultaneous Addition and Subtraction in two Independently selected Accumulating Registers	_____
1D	Operation Sums and Grand Totals	_____
2A	Positive and Negative Multiplication	_____
2B	Multiplication with Decimals	_____
2C	Chain Multiplication	_____
2D	Automatic Accumulation of Products	_____
2E	Accumulation of Multiplicands	_____
2F	Multiplication with a Constant Multiplier	_____
3A	Positive and Negative Division	_____
3B	Division with Decimals	_____
3C	Automatic Accumulation of Quotients	_____
3D	Division with Constant Divisor	_____
3E	Division with a Constant Dividend	_____
3F	Percentage Mark Up or Mark Down and Net Amount	_____
3G	Chain Discounts and Mark Ups	_____
	TEST SCORE	_____

BE 234, OFFICE CALCULATING MACHINES

FRIDEN ROTARY CALCULATOR

Module		
1	Addition	_____
2	Subtraction	_____
3	Subtraction with a Credit Balance	_____
4	Addition/Subtraction	_____
5	Constant Addition/Subtraction	_____
6	Multiplication	_____
7	Multiplication with Constants	_____
8	Multiplication, Accumulative/Negative	_____
9	Multiple Factor Multiplication	_____
10	Double and Accumulative Multiplication	_____
11	Division	_____
12	Division/Addition/Subtraction of Quotients	_____
13	Finding Percentages and Rates	_____
14	Calculating percentage of Increase or Decrease	_____
15	Multiplication and Division combined	_____
	TEST SCORE	_____

BE 234, OFFICE CALCULATING MACHINES

BURROUGHS KEY-DRIVEN CALCULATOR

Module		
1A	Addition with whole Numbers	_____
1B	Addition with Decimals	_____
2A	Multiplication with two and three digit numbers	_____
2B	Multiplication, Left of Keyboard	_____
2C	Multiple Factor Multiplication	_____
2D	Fixed Decimal Multiplication	_____
3A	Subtraction with whole Numbers	_____
3B	Subtraction with Credit Balance	_____
4	Division Stroke Count Method	_____
5	Calculating Trade Discount and Net Price	_____
6	Finding Percent of a Number	_____
7	Finding Percent of Increase and Decrease	_____
	TEST SCORE	_____

BE 234, OFFICE CALCULATING MACHINES

NCR TEN-KEY ADDING-LISTING

Module		
1A	Addition	_____
1B	Addition/Subtraction	_____
2A	Subtraction	_____
2B	Subtraction with Credit Balance	_____
3A	Multiplication	_____
3B	Short Cut Multiplication	_____
3C	Using Multiplication to find Discount, Net Amount, and Chain Discount	_____
4A	Division with Reciprocals	_____
4B	Finding Percent of Increase and Decrease	_____
	TEST SCORE	_____

BE 234, OFFICE CALCULATING MACHINES

FRIDEN PROGRAMMABLE PRINTING CALCULATOR

Module		
1	Addition/Subtraction	_____
2A	Multiplication with Decimals, Accumulation of Products, Chain Multiplication	_____
2B	Multiplication with Decimals	_____
2C	Multiplication with Accumulative Product	_____
2D	Accumulation of Product with Negative Factor	_____
2E	Chain Multiplication	_____
3A	Division with Decimals	_____
3B	Division without Decimals	_____
3C	Division with Addition of Quotient	_____
3D	Addition and Subtraction of Quotients	_____
4	Accumulation of Negative Squaring Numbers	_____
5A	Using Learning Unit for Multiplication with a Constant	_____
5B	Division with Constant Using Memory	_____
5C	Division with Constant-Dividend using Memory	_____
6	Sequential Operations	_____
	TEST SCORE	_____

APPENDIX D

BUSINESS MATHEMATICS PERFORMANCE TEST

BE 234, OFFICE CALCULATING MACHINES

BUSINESS MATHEMATICS PERFORMANCE TEST

Score your answers on the answer sheet. Use the attached blank sheet for scratch work. Show your work in section C.

Section A
(2 points for each)

1. Add .5 and .36
2. Subtract .5 from .55
3. Subtract 1/4 from .4, express your answer in decimal form.
4. Multiply 7 by .08
5. Divide 246 by .2
6. Change 72/48 to proper fraction.
7. Change 7 1/2 to an improper fraction.
8. Reduce 110/130 to its lowest terms.
9. What is the least common denominator of 1/2, 1/3, 1/4, 1/7?
10. Express 5% as a decimal.
11. Express 8% as a fraction.
12. Express 3/4 as a percent.
13. Express 4 as a percent.
14. Express .205 as a percent.
15. Express 1/2% as a decimal.
16. Extend the series 5, 8, 10, 13.
17. 1/4 plus 3/8 is equal to 7/8? true or false?

18. What is the amount of discount when a $75 item is discounted 15%?

19. What is 11.2% commission on sales of $48,000?

20. What is the single equivalent discount of 25% and 12%?

Section B
(3 points for each)

21. Of the following sets of fractions, the set which is arranged in increasing order is

(A) 7/12, 6/11, 3/5, 5/8
(B) 6/11, 7/12, 5/8, 3/5
(C) 6/11, 7/12, 3/5, 5/8
(D) none of the above

22. The number missing in the series 2, 6, 12, 20, ?, 42, 56, 72 is

(A) 30
(B) 36
(C) 40
(D) none of the above

23. If the numerator and the denominator of a fraction are increased by the same quantity, the resulting fraction is

(A) Always greater than the original fraction
(B) Always less than the original fraction
(C) Always equal to the original fraction
(D) None of the above

24. If the price of an automobile, including a 3% sales tax, is $2,729.50 the amount of the sales tax is

(A) $79.50
(B) $81.89
(C) $129.50
(D) None of the above

25. If a distance estimated at 150 feet is really 140 feet, the percent of error in this estimate is

(A) 6 2/3%
(B) 10%
(C) 7 1/7%
(D) None of the above

26. A merchant sold two radios for $120 each. One sold at a loss of 25% of the cost, and the other sold at a gain of 25% of the cost. On both transactions combined the merchant lost

(A) $64
(B) $36
(C) $16
(D) $24

27. A bicycle was purchased for $50 payable in 60 days or at a discount of 5% for cash. If the purchaser pays in 60 days, he is paying interest per annum at an approximate rate of

(A) 5%
(B) 10%
(C) 15%
(D) 30%

28. The net price of a $25 item after successive discounts of 20% and 30% is

(A) $11.00
(B) $12.50
(C) $14.00
(D) $19.00

29. The total saving in purchasing 30 13 cent ice cream pops for a class party at a reduced rate of $1.38 per dozen is

(A) $.35
(B) $.40
(C) $.45
(D) $.50

30. .125 written as a percent is

(A) 1/8%
(B) .125%
(C) 12.5%
(D) 125%

Section C
(4 points for each)

Show Your Work

31. Add .097, 175.096, .0053, .44, 28.0375, 5.0902

32. Subtract $43.65 from $53.36

33. Multiply $13.48 by 24

34. Divide $196.92 by 1.9

35. A man drove his car 25,449 miles. He used 1,630 gallons of gasoline. Gasoline costs 40.7 cents a gallon. What was the cost of gasoline per mile?

36. A owns these parcels of land--14 1/8 acres, 2 1/6 acres, and 6 3/4 acres, How much did he sell the parcels to B if B paid $240 per acre?

37. If the percentage is 80, and the rate is 2 1/2%, what is the base?

38. If 20% of 80% of a certain amount is $32.40, what is the original amount?

39. A room is 21 feet long and 5 yards wide. How much will it cost to cover the floor with carpet costing $9.00 a square yard?

40. Nancy is paid $3.40 per hour for a 36-hour week and she receives time and one half for additional hours worked during a week. How much did she earn in a week in which she worked 42 1/3 hours?

APPENDIX E

CALCULATING MACHINE PERFORMANCE TEST

NCR Ten-Key Adding-Listing Machine

1.
```
 3750
  678
 4926
    4
```

2.
```
  486
 2974
  180
   55
```

3.
```
 26.725
  3.50
 469.1
  1.75
```

4.
```
  36.42
   2.768
 127.9476
   4.1
```

5.
```
 8637
  492
```
(a) Sub
```
 2467
```
(b) Sub
```
 4876
  172
```
(c) Total ____

6.
```
  186
   25
```
(a) Sub
```
  487
  895
```
(b) Total ____

7.
```
 9869
-7253
```

8.
```
  867
  -43
```

9.
```
 5.768
-3.2
```

10.
```
 964.327
 -43.9
```

11.
```
 7469
-8325
```

12.
```
 4689
-3724
 1653
-4968
```

13.
```
-7634
 5286
 4293
-1214
```

14.
```
 -43
 769
 213
-982
```

15. 763 x 35 =

16. 3942 x 76 =

17. 43.76 x 1.276 =

18. 296.4 x 47.32 =

19. Find (a) the amount of discount and (b) the net amount when the gross amount is $345.75 and the discount rate is 3 1/4%.

20. Find (a) the amount of discount and (b) the net amount when the gross amount is $680.70. The discount rate is 6%.

21. What is (a) the net percentage and (b) the net amount when the list price is $395.75 and the trade discounts are 5%, 5%, and 10%.

22. What is (a) the net percentage and (b) the net amount when the list price is $364.25 and the trade discounts are 10%, 15%, and 5%.

Short Cut Multiplication

23. 463 x 239 =

24. 268 x 99 =

25. 2675 x 179 =

NCR Ten-Key

Find the amount of increase or decrease and the percent of increase or decrease in the following problems.

Last Year	This Year	Recriprocal	Amount of Inc. or Decrease	% of Inc. or Decrease
$ 37.90	$ 45.50	.02638	(26)	(27)
436.75	674.55	.002289	(28)	(29)
363.00	275.00	.002754	(30)	(31)
85.00	114.00	.01176	(32)	(33)

NCR Full Keyboard Adding Machine
(Please ask lab assistant for reciprocal sheet)

Addition

1.
7,509.50
4,390.65
3,659.37
9,648.37
1,865.47

2.
32
578
6902

3.
452.87
126.15
903.48

4.
384
967
425

Subtraction

5.
368
-257
-910
469

6.
-578
136
290
-175

7.
476
-732

8.
92.64
-67.87

9.
7642
-2864

10.
893
-951

11. 256 x 143 =

12. 597 x 42 =

13. 4.87 x 58 =

14. 37 x 25 =

15. 567 x 89 =

16. 352 x 78 =

17. 874 x 97 =

18. 27 x 98 =

Find the Missing Values in the Following Table:

Gross Amount	Discount Rate	Discount	Net Amount
$1.89	5 1/2%	$.10	$1.79
7.75	8 3/4%	(19)	(20)
3.65	25%	(21)	(22)
9.55	(23)	(24)	8.40
7.86	(25)	(26)	4.95
2.98	(27)	(28)	1.75

29. 47 is what percent of 105?

30. 76 is what percent of 362?

31. $89.00 is what percent of $365.00?

32. 16 feet is what percent of 49 feet?

NCR Full-Key

Find Amount of Discount and Net Amount in Following:

Gross Amount	Discount Rate	Discount	Net Amount
$628.95	4 3/4%	(33)	(34)
750.25	3 1/2%	(35)	(36)

Find Amount of Discount and Discount Rate in Following:

Gross Amount	Net Amount	Discount	Discount Rate
$ 16.75	$ 12.50	(37)	(38)
476.12	445.38	(39)	(40)

Olivetti Logos 250

1. 3654 +4211 -8312

2. 365 -421 +485

3. 353.98 - 21.86 +424.803

4. -7.1973 -3.18 +4.7635

5. (a) 985 + 363 - 471 =
   (b) 985 - 363 + 471 =

6. (a) 65 + 487 - 225 =
   (b) 65 - 487 + 225 =

7. (a) 365 + 341 - 421 =
   (b) 435 - 246 + 398 =
   (c) Grand Total =

8. (a) -98 + 45 - 30 =
   (b) 68 - 31 + 42 =
   (c) Grand Total =

9. (a) 48 x 36 =
   (b) 48 x (-36) =
   (c) (-48) x (-36) =

10. (a) 66 x 59 =
    (b) 66 x (-59) =
    (c) (-66) x (-59) =

11. -49.5 x 36.9 =

12. 38.7 x 1.988 =

13. 76 x 34 x 56 x 64 =

14. 88 x 78 x 95 x 46 =

Automatic Accumulation of Products

15. (a) 3214 x 84 =
    (b) 48 x 33.12 =
    (c) 48.6 x (-6.31) =
    (d) Sum of Products =

16. (a) -36.1 x (-481) =
    (b) 685.4 x 35.2 =
    (c) 767.5 x (-495) =
    (d) Sum of Products =

Accumulation of Multiplicands

17. (a) 476 x 312 =
    (b) 985 x 642 =
    (c) Sum of Multiplicands =

18. (a) 481 x 295 =
    (b) 686 x 712 =
    (c) Sum of Multiplicands =

19. (a) 43.12 x 8.36 =
    (b) 41.95 x 8.36 =
    (c) 59.13 x 8.36 =

20. (a) 63.98 x 18.5 =
    (b) 49.82 x 18.5 =
    (c) 54.77 x 18.5 =

21. (a) 796 ÷ 31 =
    (b) 796 ÷ (-31) =
    (c) (-796) ÷ (-31) =

22. (a) 363 ÷ 12 =
    (b) 363 ÷ (-12) =
    (c) (-363) ÷ (-12) =

23. 46.83 ÷ 4.7 =

24. 9962.5 ÷ 3.54 =

Olivetti Logos 250

Automatic Accumulation of Quotients

25. (a) 39.34 42.1 =
(b) 49.65 36.5 =
(c) Sum of Quotients =

26. (a) 98.3 40.98 =
(b) 134.5 39.81 =
(c) Sum of Quotients =

27. (a) 461 ÷ 25 =
(b) 876 ÷ 25 =
(c) 352 ÷ 25 =

28. (a) 487 ÷ 42 =
(b) 963 ÷ 42 =
(c) 868 ÷ 42 =

29. (a) 68.932 ÷ 18.8 =
(b) 68.932 ÷ 19.4 =
(c) 68.932 ÷ 17.6 =

30. (a) 495.3 ÷ 23.2 =
(b) 495.3 ÷ 22.9 =
(c) 495.3 ÷ 19.8 =

Find the Amount of Discount or Profit and Net Amount:

Gross Price	Rate of Discount	Amt. of Dis.	Net Amount
$595.95	4%	(31)	(32)
$684.85	5%	(33)	(34)

Wholesale Price	Rate of Profit	Amt. of Pro.	Net Amount
$68.92	18%	(35)	(36)
$198.95	16%	(37)	(38)

39. $369.95 plus 5% and 6%, and less 4% =

40. $54.95 plus 9%, and less 6% and 5% =

41. Henry's Clothing Store had total sales of $275,000 last year. What was the average monthly sales figure for the store?

42. Daily sales in the Men's Department of Porter's Department Store average $1,550. If five salesmen are employed, what are the total average sales for each salesman in a year's time? (Assume a 52-week year with six days in each week.)

43. Last year the ABC Vending Company earned $2,658,000. This was equivalent to $1.89 per share. How many shares of stock did the company have outstanding?

44. A local merchant made a profit of $750.50 on the sale of 1,501 pairs of sandals. How many pairs must he sell to make a profit of $850?

45. A man drove an automobile 15 miles in 20 minutes. What was his speed per hour?

Friden Programmable Electronic Calculator

1. $\begin{array}{r} 376.28 \\ -432.97 \\ +\ 84.56 \\ -\ \underline{2.93} \end{array}$

2. $\begin{array}{r} 436.29 \\ -543.68 \\ -\ 75.26 \\ +\underline{387.25} \end{array}$

3. $765 \times 43 =$

4. $287 \times 496 =$

5. $964.58 \times .723 =$

6. $824.5 \times 7.486 =$

7. $(27.23 \times 5.87) + (86 \times 7.2) =$

8. $(267.45 \times 6.8) + (43.6 \times .982) =$

9. $(364.2 \times 7.5) - (148 \times 5.6) =$

10. $7.6 \times 5.8 \times 29.3 =$

11. $(423.6 \times 1.8) - (382.3 \times 1.5) =$

12. $6.34 \times 46.3 \times 8.96 =$

13. $269 \div 43 =$

14. $5762 \div 392 =$

15. $294.58 \div 2.52 =$

16. $8963.2 \div 34.54 =$

17. $\frac{278}{3} + \frac{567}{48} =$

18. $\frac{29.74}{4.32} + \frac{76.84}{5.2} =$

19. $\frac{24}{4} + \frac{56.2}{1.78} - \frac{27.34}{7.22} =$

20. $\frac{56.3}{5.3} + \frac{54.7}{2.5} - \frac{15.8}{5.2} =$

21. $4.32^2 + 6.43^2 - 1.362^2 - 5.284^2 =$

22. $3.96^2 + 7.95^2 - 4.2^2 - .598^2 =$

23. (a) $4.96 \times 75 =$
    (b) $4.96 \times 45 =$

24. (a) $76.3 \times 42.9 =$
    (b) $76.3 \times 36.5 =$

25. (a) $293 \div 46.1 =$
    (b) $683 \div 46.1 =$

26. (a) $1242 \div 5.45 =$
    (b) $435 \div 5.45 =$

Friden Programmable

27. (a) $483 \div 24.68 =$
(b) $483 \div 17.43 =$

28. (a) $94.2 \div 8.3 =$
(b) $94.2 \div 6.54 =$

29. $\dfrac{\dfrac{46.3}{5.6 \times (8.3)^3}}{\dfrac{44.3}{3 \times 5.6 \times .4}} =$

30. $\dfrac{\dfrac{275}{4.9 \times (2.8)^2}}{7.6} =$

31. $\dfrac{(2.34)^3}{12} =$

32. $\dfrac{(.63 \times .74 \times .36)}{.042} =$

Calculate the extensions and the total of the Harris Box Company's invoice:

HARRIS BOX COMPANY

Invoice No. 37564

Date: July 15, 1974

Sold to: Mr. Robert Stack
Marquette

Product No.	Quantity	Price Per Unit	Amount
P7645	398	1.37	(33)
F2763	3,947	.0767	(34)
H4273	8,914	.0333	(35)
W7631	6,349	.0875	(36)
TOTAL			(37)

Calculate the number of men needed for the production of each product on the Manpower Schedule by dividing the units to be produced by the monthly production per man. Round all answers to the nearest whole man.

Friden Programmable

Product No.	Units to be Produced	Monthly Production Per Man	Manpower Needed
B 14656	43,250	17	(38)
B 15017	23,419	156	(39)
M 39038	48,119	67	(40)
P 16717	2,148	75	(41)
P 14758	14,119	32	(42)
		Total Manpower	(43)

Friden Rotary Calculator

1. 383.69
27.48
+ 1.56

2. 2986
5631
2046
+767

3. 386.28
-762.49

4. 9636.48
-6521.08

5. 687
-921

6. 789.78
-1026.52

7. 8634
-3257
+ 486
- 925

8. +5689
- 763
-4832
+ 193

Variable Constant:

9. 396.83 ÷ 43.28 =

   28.59 + 43.28 =

10. 768.29 - 432.63 =

    552.56 - 432.63 =

11. 267.43 x 58.6 =

12. 784.8 x 69.284 =

13.

Constant		Variable
8.36	x	269.46 =
8.36	x	29.63 =

14.

76.4	x	836.82 =
76.4	x	267.40 =

15. (5 x 8) + (7 x 9) - (9 x 3) =

16. (463.2 x 5) + (2.3 x 5) - (83.2 x 2) =

17. 36 x 29 x 84 =

18. 2.963 x 8.24 x 56.62 =

Friden Rotary Calculator

Find the total cost price and sales price in each of the following problems:

No. of Units		Cost Price	Sales Price
36	x	.24	.49
27	x	.33	.59
3	x	.67	.98
All Units		(19)	(20)
186	x	.19	.35
26	x	.72	.89
3	x	.42	.69
All Units		(21)	(22)

23. 369.28 ÷ 14.5 =

24. 286.3451 ÷ 17.28 =

25. 16 1/2% of 765.50 =

26. What percent of 875.45 is 569.25?

27. $\frac{86.34}{3.2} + \frac{24.56}{3} - \frac{34.87}{1.568} =$

28. $\frac{265.2}{12.43} + \frac{963.48}{45.6} - \frac{146.87}{7.5} =$

	Last Year	This Year
29.	$5769.43	$8768.65
30.	3768.29	2875.40

31. $\frac{568.79 \times 0.55 \times 190}{360} =$

32. $\frac{9637.43 \times .075 \times 240}{365} =$

Burroughs Key-Driven Calculator

1. 68 + 54 + 88 + 32 =

2. 791 + 345 + 871 + 345 =

3. 7954 + 1012 + 2214 + 6318 =

4. 54.3 + 68.9 + 10.8 =

5. 87.88 + 34.12 + 87.52 =

6. 1.35 + 94.31 + 75.22 =

7. 48 x 32 =

8. 79 x 85 =

9. 878 x 981 =

10. 981 x 341 =

11. 58.91 x 3.46 =

12. 79.81 x 9.851 =

13. 87.9 x 3.41 =

14. 75 x 41 x 31 =

15. 88 x 31 x 46 =

16. 86 x 34 x 59 =

17. 6.4 x 3.11 x 4.1 =

18. 5.7 x 3.4 x 13 =

19. 77.1 x 8.31 x .191 =

20. 5321 - 3248 =

21. 7981 - 4313 =

22. 4811 - 2998 =

23. 48 - 91 + 31 =

24. 198 - 651 + 211 =

25. 4112 - 9865 + 1871 =

26. (a) 8321 ÷ 55 =
(b) 832.1 ÷ .55 =
(c) 8.321 ÷ .055 =

27. 6895 ÷ 66 =
689.5 ÷ .66 =

28. 22% of 685.31 =

29. $494.34 less 5 1/2% =

Calculating Trade Discounts and Net Price

List Price	Discounts	Net Percentage	Net Price
$750.00	5/10/15	(30)	(31)
890.00	4/5/4	(32)	(33)

Finding the Percent of Increase or Decrease

Last Year	This Year	Increase (Decrease)	Percent of Increase (Dec.)
$654.00	$549.00	(34)	(35)
895.00	478.00	(36)	(37)

Underwood Olivetti Printing Calculator

Round All Answers To Two (2) Decimal Places.

Addition

1.
243
147
528
634

2.
34.07
29,04
32.38
56.93

3.
47.0672
23.15
94.571
1.6414

4.
.006
4.134
13.672
23.3687

Constant Addition

5. 235.46 + 115.76

6. 198.53 + 115.76

7. 243.31 + 115.76

8. 6.47 + 115.76

Constant Subtraction

9. 815.32 - 198.34

10. 435.74 - 198.34

11. 325.80 - 198.34

Sub-Total

841.49
-23.54
-13.65

12.

+92.16

13.

Use of Repeat Lever

14.
234
157
498
587
587
587
587

15.
345.78
345.78
345.78
345.78
345.78
435.87
543.78

Multiplication

16. 133 x .8956

17. 54.67 x 65.90

18. .65 x .0546

19. 1.975 x 56.32

20. 73.85 x 1.987

21. 354 x 465

22. 666 x 905

23. 473 x 104

24. 543 x 544

Underwood Olivetti Printing Calculator

Multiplication
With Constants

25. 314 x 201

26. 314 x 987

27. 314 x 482

28. 314 x 518

29. 18 x 43
14 x 15
13 x 12

30. 45.320 x 1.2
13.168 x 4.32
15.173 x 2.147
182.4 x 13.0467

Multiple-Factor Multiplication

31. 14 x 28 x 2 x 13

32. 18 x 27 x 7 x 182

33. 360 x 23.2 x .44 x 6

34. 11.62 x 7.24 x .062 x 3

Division

35. 219 ÷ 18 =

36. 143 ÷ 12 =

37. 4191 ÷ 28 =

38. 46.3 ÷ 39.8 =

39. 6.8 ÷ 7.236 =

40. 51 ÷ .0423 =

41. 4325.09 ÷ 3189.389 =

42. 6372.9007 ÷ 372.983 =

43. 4.7805 ÷ 32.97 =

44. 541.8056 ÷ 32.492 =

45. 6.8077 ÷ 12.893 =

The Short Haul Trailer Company's selling prices and percent of markup on the selling price are shown on the price schedule below. Calculate the markup by multiplying the sales price by the percent of markup.

SHORT HAUL
TRAILER COMPANY

Schedule of Selling Prices
June 15, 1974

Trailer #	Selling Price	Markup Percent	Markup
B10	$345.95	16 2/3%	(46)
C12	462.95	42%	(47)
C15	459.95	36%	(48)

APPENDIX F

SCORE AND TIME CHART

BE 234, OFFICE CALCULATING MACHINES

TEST SCORES

Date_____

LAB HOURS

LAB NUMBER	REQUIRED	SPENT	TEST SCORES
- 01			
- 02			
- 03			
- 04			
- 05			
- 06			
- 07			
- 08			
- 09			
- 10			
- 11			
- 12			

APPENDIX G

RAW SCORE FOR

CALCULATING MACHINE PERFORMANCE TESTS

RAW SCORE
NCR FULL-KEY

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	22	45	40	1	40
2	22	46	39	2	34
3	40	47	40	3	25
4	39	48	40	4	37
5	36	49	40	5	37
6	29	50	33	6	34
7	37	51	31	7	37
8	17	52	20	8	39
9	40	53	23	9	32
10	34	54	40	10	30
11	39	55	33	11	38
12	29	56	29	12	35
13	37	57	38	13	37
14	23	58	37	14	38
15	36			15	40
16	34			16	34
17	26			17	37
18	35			18	40
19	32			19	38
20	40			20	26
21	33			21	37
22	40			22	39
23	33			23	32
24	40			24	39
25	32			25	40
26	39			26	40
27	39			27	40
28	26			28	31
29	29			29	31
30	30			30	40
31	40			31	40
32	31			32	37
33	38			33	38
34	37			34	38
35	31			35	40
36	35			36	29
37	29			37	39
38	35			38	26
39	37			39	24
40	35			40	32
41	39			41	38
42	19			42	29
43	22			43	40
44	34			44	29

RAW SCORE
NCR TEN-KEY

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	33	45	39	1	37
2	24	46	40	2	36
3	30	47	40	3	37
4	40	48	36	4	38
5	36	49	39	5	37
6	37	50	38	6	38
7	36	51	34	7	40
8	23	52	39	8	40
9	33	53	27	9	32
10	26	54	36	10	28
11	37	55	40	11	37
12	36	56	31	12	40
13	37	57	37	13	33
14	23	58	35	14	40
15	31			15	38
16	36			16	39
17	33			17	33
18	39			18	21
19	38			19	40
20	40			20	36
21	21			21	40
22	37			22	37
23	27			23	40
24	40			24	35
25	39			25	38
26	40			26	33
27	40			27	40
28	36			28	36
29	31			29	40
30	38			30	36
31	38			31	40
32	38			32	40
33	34			33	36
34	31			34	37
35	38			35	40
36	39			36	34
37	33			37	38
38	38			38	40
39	40			39	38
40	40			40	38
41	39			41	32
42	39			42	40
43	31			43	37
44	38			44	28

RAW SCORE
OLIVETTI UNDERWOOD

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	40	45	48	1	44
2	37	46	42	2	45
3	44	47	47	3	40
4	47	48	48	4	42
5	48	49	47	5	44
6	41	50	48	6	48
7	47	51	45	7	48
8	17	52	44	8	47
9	46	53	37	9	40
10	47	54	47	10	37
11	47	55	48	11	44
12	44	56	48	12	43
13	35	57	47	13	43
14	36	58	43	14	42
15	43			15	48
16	44			16	45
17	30			17	46
18	34			18	44
19	35			19	37
20	48			20	43
21	47			21	48
22	48			22	47
23	37			23	43
24	48			24	46
25	43			25	45
26	46			26	45
27	42			27	48
28	42			28	39
29	47			29	41
30	48			30	47
31	48			31	41
32	46			32	46
33	47			33	48
34	41			34	45
35	43			35	48
36	47			36	32
37	39			37	46
38	48			38	47
39	42			39	34
40	46			40	38
41	45			41	48
42	39			42	47
43	38			43	43
44	47			44	46

RAW SCORE
BURROUGHS KEY-DRIVEN

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	31	45	40	1	37
2	33	46	33	2	35
3	23	47	37	3	32
4	35	48	39	4	29
5	23	49	40	5	26
6	27	50	37	6	26
7	31	51	33	7	40
8	10	52	34	8	40
9	40	53	28	9	34
10	29	54	35	10	24
11	29	55	36	11	33
12	30	56	37	12	36
13	35	57	37	13	35
14	29	58	32	14	39
15	31			15	38
16	38			16	34
17	22			17	34
18	27			18	38
19	39			19	36
20	40			20	31
21	25			21	40
22	38			22	38
23	31			23	38
24	39			24	33
25	23			25	34
26	35			26	37
27	40			27	40
28	24			28	30
29	31			29	38
30	39			30	40
31	39			31	40
32	38			32	39
33	38			33	40
34	34			34	37
35	34			35	38
36	38			36	21
37	18			37	39
38	37			38	40
39	36			39	26
40	34			40	18
41	39			41	40
42	37			42	37
43	30			43	32
44	39			44	16

RAW SCORE
OLIVETTI LOGOS 250

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	79	45	83	1	79
2	75	46	75	2	79
3	70	47	77	3	79
4	77	48	84	4	82
5	78	49	82	5	83
6	78	50	82	6	65
7	83	51	68	7	85
8	67	52	73	8	84
9	81	53	61	9	80
10	76	54	78	10	77
11	81	55	79	11	81
12	84	56	76	12	85
13	74	57	78	13	84
14	53	58	82	14	85
15	79			15	83
16	84			16	85
17	75			17	78
18	63			18	80
19	79			19	79
20	85			20	85
21	74			21	84
22	85			22	66
23	79			23	81
24	82			24	81
25	72			25	85
26	78			26	83
27	78			27	75
28	81			28	76
29	80			29	82
30	84			30	79
31	82			31	82
32	79			32	81
33	80			33	85
34	82			34	85
35	76			35	80
36	76			36	85
37	82			37	81
38	83			38	68
39	85			39	85
40	81			40	85
41	81			41	84
42	76			42	85
43	82			43	85
44	82			44	75

RAW SCORE
FRIDEN PROGRAMMABLE

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	48	45	44	1	48
2	49	46	49	2	49
3	48	47	49	3	48
4	43	48	49	4	47
5	49	49	49	5	46
6	46	50	49	6	47
7	46	51	47	7	49
8	32	52	43	8	45
9	48	53	30	9	45
10	47	54	43	10	40
11	49	55	48	11	48
12	44	56	48	12	49
13	43	57	48	13	43
14	45	58	48	14	46
15	45			15	46
16	40			16	47
17	45			17	49
18	47			18	48
19	48			19	48
20	49			20	44
21	45			21	49
22	49			22	49
23	44			23	42
24	49			24	49
25	49			25	49
26	46			26	49
27	48			27	49
28	34			28	46
29	47			19	43
30	49			30	48
31	48			31	47
32	49			32	49
33	47			33	49
34	48			34	49
35	48			35	49
36	49			36	42
37	49			37	49
38	48			38	46
39	49			39	48
40	47			40	43
41	48			41	49
42	48			42	46
43	47			43	47
44	49			44	48

RAW SCORE
FRIDEN ROTARY

FALL				SPRING	
Student #	Score	Student #	Score	Student #	Score
1	25	45	35	1	34
2	34	46	33	2	32
3	31	47	33	3	21
4	29	48	32	4	35
5	33	49	33	5	28
6	30	50	35	6	16
7	29	51	34	7	32
8	23	52	34	8	36
9	28	53	28	9	32
10	21	54	20	10	29
11	31	55	34	11	29
12	30	56	30	12	35
13	34	57	30	13	30
14	32	58	31	14	33
15	23			15	34
16	36			16	32
17	16			17	30
18	22			18	33
19	29			19	33
20	35			20	20
21	31			21	36
22	31			22	33
23	17			23	35
24	27			24	27
25	21			25	29
26	32			26	36
27	34			27	35
28	20			28	25
29	28			29	27
30	36			30	35
31	32			31	34
32	24			32	35
33	27			33	36
34	26			34	33
35	22			35	35
36	32			36	22
37	32			37	32
38	30			38	35
39	31			39	26
40	23			40	18
41	33			41	34
42	35			42	27
43	28			43	27
44	33			44	32

APPENDIX H

RAW DATA FOR TIME

TIME RECORD

FALL				SPRING	
Student #	Hours	Student #	Hours	Student #	Hours
1	16.75	45	10.25	1	9.50
2	26.00	46	22.50	2	16.50
3	29.00	47	22.75	3	29.50
4	22.75	48	10.25	4	39.50
5	19.75	49	38.00	5	26.75
6	21.75	50	13.25	6	30.75
7	24.75	51	41.00	7	33.25
8	20.00	52	22.25	8	33.25
9	37.50	53	13.25	9	24.75
10	24.50	54	18.25	10	24.25
11	31.25	55	19.75	11	40.00
12	23.25	56	24.25	12	44.00
13	30.50	57	34.75	13	20.50
14	30.25	58	33.00	14	40.25
15	10.75			15	11.00
16	24.50			16	41.50
17	30.25			17	15.25
18	15.25			18	19.75
19	33.50			19	20.75
20	47.00			20	25.50
21	41.50			21	24.50
22	25.75			22	39.75
23	46.25			23	34.00
24	39.00			24	29.25
25	23.25			25	32.25
26	33.00			26	6.00
27	37.75			27	19.50
28	31.50			28	35.50
29	24.75			29	22.00
30	56.75			30	5.00
31	25.00			31	37.00
32	21.00			32	31.25
33	18.50			33	24.50
34	23.25			34	6.75
35	6.50			35	31.00
36	28.00			36	34.00
37	26.25			37	27.25
38	13.50			38	44.25
39	29.25			39	13.75
40	9.25			40	18.00
41	19.50			41	28.75
42	23.25			42	22.25
43	17.75			43	19.50
44	22.75			44	32.75

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